

brainhack

Report from 2015 OHBM Hackathon (HI)

DIPY: Brain tissue classification

Project URL: <https://github.com/villalonreina/dipy/tree/pve>

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1 Introduction

To implement an image segmentation algorithm in DIPY [1] for classifying the different tissue types of the brain using structural T1 images and diffusion MRI images (dMRI) as well as to incorporate tissue probability maps for Anatomically-Constrained Tractography (ACT) [2].

DMRI is used for creating visual representations of the structural connectivity of the brain, also known as tractography. Research has shown that using a tissue classifier can be of great benefit to create more accurate representations of the underlying connections [3].

2 Approach

We used a Bayesian approach for the segmentation [4, 5] by applying the Maximum-A-Posteriori (MAP) procedure. The prior probability was modeled with Markov Random Fields (MRF). The MRF distribution was modeled as a Gibbs distribution. We used the Expectation Maximization (EM) algorithm to update the tissue labels at each site and to update the parameters of the log-likelihood in all iterations.

3 Results

The first row of the figure shows an example T1 structural image, the initial segmentation and the final segmentation after 12 iterations and $\beta=0.01$. β determines the weight of the neighborhood in the MRF model. The second row shows the probability maps of the three main tissue classes of the brain. These maps were used in the ACT algorithm and improved fiber tracking.

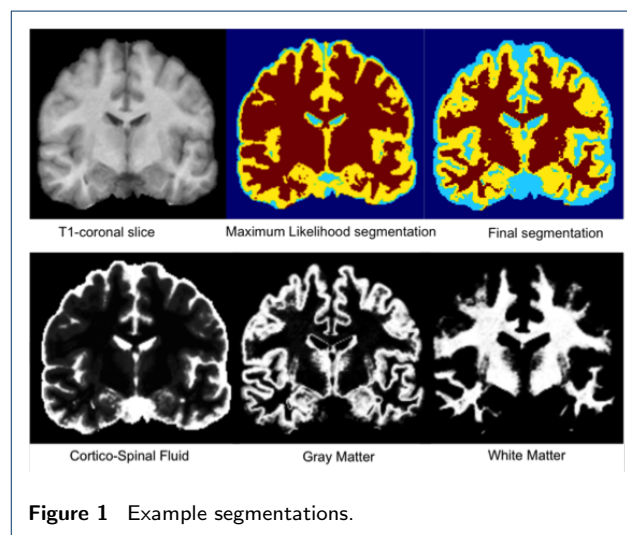


Figure 1 Example segmentations.

4 Conclusions

We developed a segmentation algorithm based on a Bayesian framework by using the MAP-MRF approach and EM. The algorithm was tested on T1-weighted images as well as on dMRI derived maps, such as the Diffusion Power Maps (DPM) [6]. The tissue specific probability maps from both the T1 and the DPMs were then used for ACT.

Availability of Supporting Data

More information about this project can be found at: <https://github.com/villalonreina/dipy/tree/pve>.

Competing interests

None

Author's contributions

Julio E. Villalon-Reina and Eleftherios Garyfallidis performed the project and wrote the report.

Acknowledgements

The authors would like to thank the organizers and attendees of the 2015 OHBM Hackathon. Julio E. Villalon-Reina was funded by Google Summer of Code 2015.

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